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NONTRADITIONAL AGRICULTURAL EXPORT PRODUCTION ON SMALL FARMS IN HIGHLAND GUATEMALA: LONG-TERM SOCIOECONOMIC AND ENVIRONMENTAL IMPACTS

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This paper analyzes the long-term economic, social, and environmental impacts of nontraditional export agriculture for Kaqchikel Maya farmers in the Central Guatemalan highlands. Unlike many other nontraditional export sectors, production of snow peas, broccoli, and other vegetables and fruits has been dominated by small-scale growers in the Guatemalan highlands for some 25 years. While early research studies reported economic gains for small-scale NTAE producers, studies from the early and mid-1990s exposed environmental and social costs of nontraditional export agriculture in this region and examined market imperfections and policy failures that limit the potential of small-scale production to provide a sustainable livelihood and to alleviate poverty.

The research results reported in this paper are based on household- and individual-level surveys conducted in two Maya communities in Chimaltenango Department during 1998 and 2001. Quantitative and qualitative data encompass a range of variation in access to means of production and marketing, environmental degradation, and social structures that is representative of the region. These results show that most small-scale producers view NTAE production as a viable opportunity for economic advancement, one that works more to their advantage than against it, and that most have managed to stay in the market for several years following initial adoption. Further, both NTAE producers and nonproducers in the study communities view local long-term economic and social changes following NTAE adoption as positive. In an attempt to sort out the apparent contradictions between the generally positive perceptions of Maya farmers concerning the economic and social impacts of NTAE production and the largely negative assessments of reports from the 1990s, we present evidence of positive distributional effects of

NTAE production, modest progress in addressing environmental problems, and farmers' strategies for self insurance to compensate for market imperfections.

REVIEW OF RELEVANT RESEARCH

Constraints to Economic and Environmental Sustainability of NTAEs in the Small-scale Sector

During the early years of small-scale NTAE production, adopters of these crops were able to increase family incomes; off-farm employment in packing plants and other operations also dramatically increased (von Braun and Immink 1989). At the macro level, small-scale production of NTAEs contributed significantly to export earnings (Thrupp, Bergeron and Waters 1995). Over the course of two decades, however, a growing body of literature has documented nonsustainable production and marketing constraints faced by small-scale producers of snow peas, broccoli, and other NTAEs in the Guatemala highlands and elsewhere in Central America. Nonsustainable soil degradation and other environmental problems, health costs, and social displacements have also been widely associated with NTAE production. Together these economic, environmental, and social constraints threaten the potential of NTAEs to foster sustainable economic growth and to alleviate poverty in the small-scale agricultural sector.

Most of the studies challenging the sustainability and poverty-reduction distributional effects of NTAE production in the small-scale sector concentrate on market failures and the inability of national and international development programs to solve these. In some areas, farmers with very little land have achieved sufficiently high incomes per area planted to NTAE crops to permit the purchase of additional land from larger-scale producers (Carter and Mesbah 1993; Carletto, deJanvry and Sadoulet 1999). However, the long-term sustainability of growth in the small-scale NTAE sector is threatened by increasing price uncertainty in maturing niche markets and U.S. rejection of produce with pest or pesticide-residue contamination. Further, soil depletion-- associated with rising land pressure in imperfect markets and nonsustainable agrochemical use-- limits the potential of NTAE production to contribute to sustainably increasing incomes (Carletto, de Janvry, and Sadoulet 1999). Nonsustainably high levels of agrochemical use in the small-scale NTAE sector have resulted in the all-too-familiar “pesticide-treadmill” effect that decreases crop yield and product quality, as well as in increasing soil toxicity (Thrupp, Bergeron and Waters 1995).

Capital and risk constraints are key factors that underlie the small-farm adoption ceiling identified by Bradford Barham and Michael Carter and colleagues (Barham, Carter, and Sigelko 1995) and also by Joachim von Braun, Maarten Immink and colleagues (von Braun, Hotchkiss and Immink 1989; Immink and Alarcon 1993). In contrast to large-scale producers who plant up to 100% of their land to NTAEs, producers with less than four hectares are likely to plant only around one-third hectare to these high-value crops. Small-scale producers are constrained by lack of both production credit and the need to self-insure against stochastic shocks such as catastrophic crop losses and price drops. These producers self-insure by diversifying their crop mix to include less-remunerative crops destined for domestic and other Central American markets and by growing basic foodstuffs whose expected return is only a fraction of the value of NTAE production (von Braun, Hotchkiss and Immink 1989; Immink and Alarcon 1993). While recent research has demonstrated that many small-scale producers are not constrained with respect to formal credit (Johnson 2001), studies based in the central highlands of Guatemala consistently find that low-income producers are credit-constrained and could benefit from decentralized, market-based credit unions and other forms of production-credit associations (Barham, Boucher and Carter 1996; Immink and Alarcon 1993). Small-scale farmers' critical need for insurance could be addressed through provision of crop insurance (Carter and Coles 1998) and through loan default insurance (Carletto et al. 1999) and other forms of ex-post access to capital that enable farmers to leverage borrowing (Carter and Mesbah 1993).

The potential for the production of high-value export crops to alleviate poverty and enable social mobility through sustainably increasing production in the small-scale sector may also be constrained by land tenure structures that mitigate against a supply of land for purchase or rental, even if producers are economically motivated to buy land and do realize sufficient returns to purchase or rent additional land. While small-scale producers have been able to increase holdings through purchase from larger farms-- thus broadening the distribution and potential sustainability of NTAE production--underlying agrarian political and economic structures continue to favor large growers (Carter and Barham 1996).

The most recent Agricultural Census (1979) reports that Guatemala has an extraordinarily unequal distribution of land; the Gini index for Guatemala is .85 (perfect inequality = 1) (Carter, Barham, and Mesbah 1996, p. 52). A recent World Bank analysis of land markets in Guatemala posits that "large landowners do not want to sell to small landholders because they fear that such

actions could increase demands for land redistribution and land invasion" (World Bank Report No. 12313-GU, p. 25). In such circumstances, improved access to product markets and factors of production other than land may not be sufficient to result in substantial land transfers from larger farms to smaller farms. Since adopters of NTAEs are more likely to increase their landholdings than nonadopters (Carletto, deJanvry and Sadoulet 1999), their only recourse may be to buy out smallholders who have been unable to switch to higher-value crops. The limited market-based redistributive mechanisms that have been instituted in Guatemala have not resulted in substantial transfers of land and farmers who have participated have often been unable to repay their loans owing to lack of access to other factors of production (Carter and Barham 1996). For all of these reasons, it is often posited that NTAE adoption in the smallholding sector will lead to increasing land concentration and economic inequality.

Misuse of agrochemicals has serious economic, environmental, and human health costs (Thrupp, Bergeron and Waters 1995; Arbona 1998; Murray and Taylor 2000). The USAID-funded IPM CRSP, together with the Guatemalan Ministries of Agriculture and Finance and the U.S. Department of Agriculture Foreign Agricultural Service (USDAFAS) Guatemala, has carried out research demonstrating that snow peas can be produced with lower costs, higher yields, and improved quality by decreasing reliance on chemical pesticides and instituting integrated pest management practices (Julian, Sullivan and Sánchez 2000). Pre-inspection protocols were developed that would dramatically reduce the proportion of snow pea production that is lost to detentions and rejections at ports-of-entry due to sanitary and phytosanitary violations (Sánchez et al. 1998). However, the limited availability of information on good production management practices and producer training constrain the adoption of production and postharvest technologies that lead to more sustainable economic and environmental benefits at the producer level and throughout the production-processing-marketing value chain (Sánchez et al. 1998). Small-scale producers who are affiliated with cooperatives or who market products directly through contracts with exporters are most likely to have access to the information and technology that protect against crop loss and product rejection (Julian, Sullivan and Sánchez 2000).

Social Displacements

Social displacements have been associated with NTAE production in this context. Goldin (1996) found a close link between upward socioeconomic mobility and the adoption of nontraditional crops within a Maya population in the Western highlands. This mobility accelerated class differentiation. A number of other studies concluded that the benefits of nontraditional production tend to be concentrated in a small echelon of local landholding elites, and that NTAE production threatens subsistence bases as well as increasing socioeconomic inequality (Goldin and Saenz 1993, Lee 1993, AVANCSO 1994, Carletto 1996).

Studies of intrahousehold resource allocation and decision-making found that NTAE production perpetuated or exacerbated gender inequalities. In the central Guatemalan highlands, the ownership and control of land and the management of production and consumption budgets are strongly differentiated by gender. Women have traditionally earned incomes through craft production, storekeeping, small animal production, and selling nonagricultural products in regional markets, while men were primarily responsible for subsistence agricultural production. Separate budgets for subsistence (food, clothing, domestic technology) and agricultural production were managed by women and men respectively. Earlier studies from the region concluded that household adoption of NTAEs resulted in increased field labor for women, who could be forced to decrease the amount of time devoted to independent income-producing activities (von Braun, Hotchkiss, and Immink 1989). Since men dominate the marketing of NTAEs through cooperatives and other market channels, while women are responsible for stretching the household subsistence fund they administer to cover food and many domestic expenditures, women depend on their spouses to share receipts in a manner that compensates for any decrease in their own independent incomes. One study found that, although women did not give up independent income-earning activities when they took to the NTAE fields, they received a smaller proportion of incremental income derived from NTAE production than did women whose households' income increments derived from other sources (Katz 1995). Within the wide range of variation has been recorded for highland Maya gendered inheritance practice (Hill and Gollas 1968; Gross and Kendall 1983; Bossen 1984: 86-92; Fundación Arias/Tierra Viva 1993;Asturias de Barrios and Tevalán 1996; Deere and León 1999) Kaqchikel populations have been characterized as patriarchal with respect to landholding and land-use decision-making (even on women's land) as well as with respect to control of agricultural incomes and other economic

resources (see Katz 1995, Nieves 1987). Thus the expectation exists that women will be unable to prevent their households from devoting productive assets to NTAE production yet will not receive benefits from NTAE production commensurate with their contributions of labor and other resources (see Hamilton, Asturias de Barrios, and Tevalán 2001).

Countervailing Socio-cultural Assets

Indigenous small-scale producers are possessed of important assets that can counter constraints to sustainable production and social displacements. These assets include family labor, parallel marketing experience outside the NTAE sector (cultural capital), high levels of social capital, and indigenous knowledge of integrated pest management (Morales and Perfecto 2000). Perhaps surprisingly, the availability of family labor may not be the most viable of these assets. While underdeveloped rural labor markets do lower the opportunity costs of family labor, and the fragile NTAE hybrids do require high field and supervisory labor inputs, this is a false economy in the sense that a better form of rural development would be to improve educational and employment opportunities in rural areas as a means of raising incomes and decreasing emigration. Thus the presence of unpaid family labor and relatively inexpensive community labor is not an unmixed blessing, even to NTAE producer families. Families subsidize the marginal cost of family labor through their own subsistence production, and the anticipated inverse relationship between plot size and productivity has generally held.

Recent research in Chimaltenango suggests that indigenous men and women have been able to leverage marketing experience in the textile and regional agricultural markets to maintain control of their means of production while participating in global markets (Hamilton 2000; Hamilton et al. 2000; Fischer 2001). Small-scale NTAE producers in Chimaltenango have accumulated productive resources sufficient to achieve significant social mobility. These economic gains may be attributed to a trickle-down effect of sub-contracted production that allows small-scale producers to retain control of their means of production; this process has produced an upwardly mobile class of Maya farmers with sufficient resources to pursue long-term socio-economic gains (Fischer 2001). While the distribution of income within indigenous populations may become more uneven, the overall distribution of rural income becomes less uneven in this context. It appears that indigenous farmers who were able to expand their holdings through NTAE production were more likely to obtain additional land from the ladino rural elite than from less fortunate indigenous landholders. Given the social, political, and

economic marginalization of indigenous peoples in highland Guatemala, these findings are an important contribution to the analysis of the distributional effects of NTAE production in the small scale sector. Contracting directly with exporters allowed small-scale producers to obtain better terms of trade by bypassing market intermediaries in regional bulking centers. Indigenous women appear to have transferred skills and social capital gained through marketing agricultural and nonagricultural products in regional bulking centers and other markets to the marketing of NTAEs. Maintaining their visibility in marketing activities may have helped to protect women's control of household productive assets and incomes despite the more visible roles of men in NTAE cooperatives and other production organizations (Hamilton, Asturias, and Tevalán 1999; see Asturias and Tevalán 1996).

Social capital arising from deeply embedded social norms and cultural values has been well documented among Maya communities in the Guatemalan highlands (Katz 2000) and comparable indigenous groups elsewhere in Latin America (Hamilton 1998; Fox 1996; Bebbington 1999).[1] A wide variety of producer organizations has been able to capitalize on

[1] Recent scholarship concerning agricultural modernization and export market integration by indigenous highland Ecuadorean peoples has demonstrated a set of outcomes that many analysts find contradictory. On the one hand, the adoption of high-technology production and successful manipulation of export market channels have been uneven in indigenous communities and produced increasing socioeconomic stratification and inherent intra- and inter-community tensions (Colloredo-Mansfeld 1999, Korovkin 1998). On the other hand, locally-based export economies have also fostered socio-economic upward mobility for startup micro-entrepreneurs and enabled more members of producer families to remain employed in their home communities—a "regionally specific alternative to full-fledged capitalism" (Korovkin 1998: 146). Further, nontraditional production and export marketing have served to reinforce traditional socio-economic reciprocity and variously-conceived forms of ethnic identification (Colloredo-Mansfeld 1999), as well as to increase political solidarity, local control of development processes, and national political participation (Bebbington 1996, Cruz 1999). As in Guatemala, agricultural modernization and export market integration have contributed to a reconfiguration of inter-ethnic relations at the local and regional levels (Meisch 1998).

Sociocultural traditions have enabled indigenous Ecuadorean producers to compete in new markets while simultaneously strengthening indigenous identity and political power. Preservation of kinship, community, and wider political-economic reciprocity networks has proved essential for success in artisan export markets (e.g., Colloredo-Mansfeld 1999: Chapter 4). For agriculturalists, this is also the case (Hamilton 1998: Chapters 2 and 3). But beyond the dyadic associations that are critical for economic success, indigenous Andean forms of social contracts have also provided a basis for economic growth without further impoverishment of non-elites and without permanently separating workers from the means of production (Korovkin 1998). Traditional forms of community social and economic reciprocity and collaboration have provided the social-capital base for indigenous production organizations to achieve competitive status in new markets and reduce poverty, often with the help of external development organizations. North and Cameron (2000) demonstrate how indigenous producer organizations in one of the poorest, most isolated sectors of the Central Highlands socialized profits from dairy production to enable market expansion, local control, and poverty reduction. Bebbington, building on analytical studies by Fox (1996), finds that indigenous social capital can be scaled up in partnership with external organizations and can provide a basis for indigenous organizations to achieve greater household and community access to productive and socio-political resources (1999). Both Bebbington (1993) and Cruz (1999) analyze ways in which indigenous organizations have chosen to internalize those aspects of agricultural modernization that will enable them to

many generations of normalized economic reciprocity and high levels of trust—qualities that have been identified as essential for enabling credit unions and other associations to relieve production and marketing constraints (Petty and Ward 2001; Uphoff and Wijayaratna 2000; Bebbington 1999; Barham, Boucher and Carter 1996). Organizational structures that allow vertical integration of production, processing, and marketing often enable small-scale farmers to apply their social capital in ways that capture both greater market share and higher returns for investment (see Immink and Alarcon 1993 for recommendations targeted to the Guatemalan highlands).

Edward Fischer[2] has described one program in Chimaltenango, Aj Ticonel, that trains farmers in nontraditional production techniques to maintain quality standards, then buys their produce, packs it, and sells it directly to wholesalers in Miami (Fischer 2001; Fischer, Hamilton, and Asturias de Barrios 2001). Profits are returned to farmers at the end of the year as dividends. This program encourages farmers to maintain subsistence production of maize (in satisfaction of both subsistence needs and cultural valuations placed on traditional maize production) while planting their best lands to the more economically profitable export crops. Aj Ticonel also builds business relationships around social trust. They hire farmers' family members to work in the packing plant and provide maternal leave benefits and health care. These practices help to sustain economic bases in ways that provide benefits to all family members and are viewed as socially acceptable.[3]

CASE STUDY RESULTS: Xenimajuyú and Xeabaj

The research population comprises two primarily Kaqchikel Maya communities in Chimaltenango Department, the leading snow pea export production area in Guatemala and also

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compete without abandoning ethnic identity or political affiliation. Bebbington states that indigenous federations promote production of nontraditional, high-technology cash crops as an 'indigenous' political economic strategy because such intensification and penetration of new markets increases income and reduces out-migration, perpetuating "group cohesion and forms of self-management" (1993). Thus socio-cultural traditions and nontraditional market integration are mutually reinforcing: social capital provides a basis for the collaboration that enables small-scale producers to compete in nontraditional markets, while market integration leads to both greater income and strengthened political-economic position.

[2] Edward F. Fischer has collaborated with the authors on studies concerning the economic, social, and cultural impacts of NTAE production in Chimaltenango (Fischer, Hamilton, and Asturias de Barrios 2001). Dr. Fischer has provided invaluable field data from our study region that helped us understand Maya cultural logics and agricultural structures and practices. We wish to acknowledge the contribution of his information and insights.

[3] Edward F. Fischer noted that Peter Benson who worked with him in the field interviewing and analyzing data on Aj Tikonel.

a broccoli export center. Xenimajuyú is located on the Interamerican Highway in the municipality of Tecpán and has a population of 1151. Xeabaj is located 12 km off-road from the same highway in the municipality of Santa Apolonia and has a population of 917. Quantitative analysis is based on (1) a 1998 probabilistic-sample survey of 141 households from a population of 406 households and (2) a follow-up 2001 survey of 214 men and women from a ramdomized subsample of 113 households.[4] Of the 94% of the population self-identified as Kaqchikel, nearly all women and men are bilingual in Kaqchikel and Spanish. The religiously-affiliated majority of households are divided nearly equally among Roman Catholic and Protestant denominations. Two-thirds of households are comprised of nuclear families; 9% are headed by single women.[5]

The local economy is agriculturally based; over 80% of male household heads reported household agriculture as their primary occupation and half of all households included members who earned wages as agricultural laborers. Two-thirds of households sold animals during the year of the survey and 7% ran agricultural wholesale businesses. Nonagricultural income sources included services (25%), textile artisanry (37%), earthenware artisanry (17%) and storekeeping (3%). Of the 95% of households that planted crops, around one-third planted only maize and other crops for household consumption. Among 87 commercial producers, 66 planted nontraditional export crops (NTAEs), primarily snow peas and broccoli for export to U.S. markets. The rest planted only crops sold in domestic markets or to intermediaries who buy for the Salvadoran market--primarily potato, strawberry, cabbage, and maize. A large minority of NTAE growers also produced for domestic and Salvadoran markets. Virtually all commercial producers also grew subsistence crops.

The distribution of land among households is highly and positively skewed. One-fifth of households do not own land and an additional three-fifths own less than 1 ha; only 3% of households own 5 or more ha and one household owns 33 ha. At the median, households own slightly less than one-half hectare. Half of the households that practice agriculture rent land for

[4] Case study research was carried out under the auspices of the Integrated Pest Management Collaborative Research Support Program, funded by the U.S. Agency for International Development Global Bureau (Agreement No. LAG-4196-G-00-5001-00 and Grant No. LAG-G-00-93-00053-00. This paper does not necessarily reflect the views of the agency. Survey data were collected by members of Estudio 1360, directed by Linda Asturias, in consultation with Sarah Hamilton and Liliana Goldin. The 1998 survey instrument was designed by Linda Asturias, Sarah Hamilton, and Liliana Goldin. The 2001 survey was designed by Sarah Hamilton and Linda Asturias. Members of Estudio 1360 contributed to survey design and revision.

[5] See Asturias et al. 1999 for descriptive information concerning demographic, social, and agricultural variables in the study communities.

production; most of these households are located in Xenimajuyú, where landholdings tend to be smaller.[6] When the total amount of land accessed by households (including land rented in and excluding land rented out) is considered, only 4% do not access land, but 71% still access less than 1 ha and the proportion with 5 or more ha is reduced by only 1%. At the median, households access only .62 hectare. Further, only 30% of households access irrigated land. The remainder who produce NTAEs must rely on rainfall and residual soil moisture, which contributes to the high levels of pest contamination and use of toxic chemicals associated with these crops.

Smallholders move in and out of NTAE production for a variety of reasons, including increasing price uncertainty, U.S. rejection of produce with pest or pesticide-residue contamination, soil depletion associated with rising land pressure over scarce land, and the inability to access capital and/or absorb losses (Carletto, de Janvry, and Sadoulet 1999;Barham, Carter, and Sigelko 1996). NTAEs were first adopted in Xenimajuyú in 1981 and in Xeabaj in 1988. During 1998, most NTAE producers planted less than one-fourth ha to these high-value crops. Producers diversified production in order to manage risks associated with NTAE production; take advantage of more direct access to domestic and Salvadoran market outlets for NTAEs other than snow peas and broccoli; and feed their families and livestock.

Access to agricultural infrastructure is limited in these communities. Although many Guatemalan smallholders produce and market nontraditional export crops through cooperatives, the local market is dominated by private intermediaries and contract production with

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[6] In Xenimajuyú, nearly one-fourth of the sample (N = 87) does not own land, while half own between .03 and .45 hectares. Nearly all of the remaining households hold between .5 and 2.5 hectares. The largest landholding reported is only 6.3 hectares. The total amount of land held by the households in the sample is only 40.5 hectares. In this community there is a great deal of renting in of land and little renting out; thus rental enables many more families to access land. Amounts accessed remain relatively small; the total amount added through rental is 20 hectares. Among the 83 families (97% of the sample) who access land, nearly half have less than .5 hectares and only 4% have more than 2.5 hectares. Among those with land, the mean holding (using 5% trimmed mean) is .64 hectares (SD .75). The amount of land accessed includes land rented in; any land rented out is deducted.

In Xeabaj (N = 54), both total amounts of land owned by sampled households (102.2) and the proportion who hold between .5 hectares and 2.5 hectares (57%) are larger. In addition, 13% own between 2.5 and 10 hectares, and one household owns 32.6 hectares. When renting of land is taken into consideration, the picture changes much less than in Xenimajuyú. The number without land drops from 11% to 6%; the number with less than .5 hectares changes from 17% to 15%; the number with between .5 and 2.5 hectares rises to 63%; the number with between 2.5 and 10 hectares includes one additional household, and the household with 33 hectares does not rent in or out. In Xeabaj the mean amount of land accessed (5% trimmed mean) is 1.4 hectares (SD 4.7). On average, farmers in Xeabaj control more than twice as much land as those in Xenimajuyú; medians reflect the same pattern (.9 for Xeabaj and .45 for Xenimajuyú).

agroexporters. Some 12% of male household heads and 3% of female heads belong to groups self-organized to market nontraditional exports through contracts with agroexporters. These individuals, and a few others, participate in the USAID-funded Integrated Pest Management Collaborative Research Support Program aimed at developing integrated pest management strategies and pre-inspection protocols that enable small-scale producers to reduce losses owing to pest damage and failure to meet relatively stringent U.S. pesticide- residue tolerances. Among snow pea producers, 83% sold to intermediaries and only 8% to an exporter. Among broccoli producers, 72% sold to an exporter, while 29% sold to an intermediary. Price differentials among marketing outlets were greatest for snow peas; producers whose local organization sold through exporters made one-third more than those who sold to intermediaries.

Economic and Social Impacts: Distribution of NTAE Production by Farm Size

The following analysis tests whether there is a threshold in household land access below which a household cannot or will not produce NTAEs, and whether controlling relatively larger amounts of land correlates with planting larger amounts of land to NTAEs. These data are cross-sectional and do not include measures of the length of time that producers have planted NTAEs. They report only the amount of land accessed by households and planted to NTAEs during the 1997-1998 production cycles.

Several statistical tests were performed to determine the relationship between the amount of land available to a household and the amount of land planted to NTAEs. As these data are cross-sectional, significant associations may reflect (1) the amount of land a household must have before it is considered potentially advantageous to plant NTAEs or (2) accumulation derived (at least in part) from past production of these high-value crops. The bivariate linear correlation between the total amount of land accessed by households (land owned plus land rented in and minus land rented out) and the land surface planted to snow peas and broccoli is positive and significant but not particularly large ($r = .424$, $p = .000$, one outlier removed).

In order to better understand the nature of the association, Gamma and Analysis of Variance tests were performed to determine if there are thresholds in land access that correlate with adoption of NTAEs or with the amount of land planted to nontraditionals (Table 1). When the sample of those who control land is ranked into 4 groups representing households with (1) less than .5 hectares, (2) .5 - .99 hectare; (3) 1 - 2.49 hectares; and (4) more than 2.5 hectares,

results show that although the number of households planting NTAEs increases significantly along with greater access to land (Table 1; Gamma test), the amounts planted to NTAEs differ significantly only between those with the smallest and largest amounts of land. Table 1 also presents results of Analysis of Variance tests for a subsample including only those 66 households planting NTAEs. Amounts planted by NTAE producers do not differ significantly among those who control fewer than 2.5 hectares. The range in surface planted to NTAEs varies from .06 hectares to .68 hectares; most producers plant only .11 hectares, with half of those in the third tier planting between .2 and .6 hectares. Even among those in the top tier, only one producer planted more than one hectare. No one in the sample planted more than one half of household land to NTAEs, and most planted less than one fourth of their land to NTAEs.

These data show that most households with less than .5 hectare either were unable to produce NTAEs or decided that it was not in their best interest to invest their land, labor, and cash in NTAEs. Even for those with more land, production of NTAEs was clearly only one part of a diversified portfolio of household agricultural activities.

A lively land market exists in the area, fueled in part by NTAE production. Thirty-seven percent (N = 78) of the sample reported they had bought land since NTAEs were introduced in the communities. Half of these individuals (N = 39) used receipts from NTAE production for land purchase. Of the 39 individuals who reported having sold "a little" of their land during the this time period, 7 said that NTAE production or marketing losses had contributed to their decision to sell. Most of these continue to produce NTAEs; five reported that their economic situation is better than before NTAE production; 2 said there was no change; and only one reported being worse off. The two individuals who reported selling a larger proportion of their land were a husband-wife pair who own the largest farm in Xeabaj—currently 32.6 has. These two household heads indicated that NTAE production was implicated in their decision to sell, but they continue to produce and also said that their overall economic status had not been impacted negatively by NTAE production.

One-third of households rented in land for NTAE production, the same proportion that rented in land for other crops (some households rented for both production regimes). Nine percent rented out land to NTAE producers.

Given the relatively high return for household labor and input investment in NTAEs and the scarcity of remunerative off-farm local employment, nontraditionals appear to offer

smallholders in these communities their best current chance at increasing accumulation. However, producers with very little land will remain committed to a diversified production portfolio precisely because they cannot afford to take the risks associated with planting more of their land to NTAEs, and also because, for cultural as well as economic reasons, they prefer to provision their households with maize from home production. Thus the most likely scenario is that NTAE production to will contribute positively but slowly to sustainable increases in income and accumulation for most producers in these communities.

Economic and Social Impacts: Local Perceptions

Survey respondents were asked in 1998 if people were doing better or worse economically than before NTAEs were locally produced. 60% believed that people were doing better; 24% perceived no economic change; and 16% felt that people were worse off. When respondents were asked to evaluate overall change in their communities, even more responded positively. 81% concluded that, in general, change had been positive. Only three percent said there had been no change and 16% said change had been negative. There were no statistical differences between NTAE producers and nonproducers on either measure: sign. T = .620 for economic change; sign. T = .461 for general change. Oneway analyses of variance tested for differences among households according to strata of landholding; there were no significant differences on the measure of economic change (sign. F = .135) or general change (f = .799). Similarly, when NTAE production was ranked according to the number of hectares planted by households, no differences emerged among groups on the measure of economic change (sign. F = .508) or on the measure of general change (sign. F = .642).[7]

A second survey was carried out in Xenimajuyú and Xeabaj in July, 2001.[8] A subsample of 214 individuals (male and female household heads) from 113 households was randomly selected from the original household sample. The purpose of the survey was to measure more precisely local perceptions of the long-term social and economic effects of NTAE production at the household and community levels and to collect production histories. During the production cycles that began in July, 2000, 72 households (64%) planted snow peas and 15 (13%) planted

[7] For a parallel discussion of economic ideology and NTAE production based on this household survey, see Goldin and Asturias, 2001.

[8] A similar survey was carried out in San Mateo Milpas Altas, Sacatepéquez, in 2001. Results are published in Hamilton, Sullivan, and Asturias de Barrios 2001.

broccoli. The increase in proportion of NTAE producers reflects the fact that 23 % of snow pea producers and 30% of broccoli producers began planting after the original 1998 survey.

All respondents answered a global question concerning the economic trajectory of their families over the past twelve to twenty years, the period of time during which nontraditionals have been grown in the two communities. Respondents were asked if their economic situation were better, the same, or worse than before NTAEs were planted in the community. If they answered "better," they were asked if they were much better off than before the arrival of NTAEs. If they answered "worse," they were asked if they were much worse off than before NTAEs arrived. (Even relatively young household heads answered this question--referring to their families of origin rather than their families of procreation.) Responses are summarized in Table 5. The impact perception picture is somewhat more positive than that of 1998. Considering the sample as a whole, 57% of people felt they were better off than before nontraditionals came to the community, while only 6% felt they had lost ground since NTAEs arrived. A sizeable minority (37%) felt their economic situation had not changed. While responses were indicative of positive economic change following NTAE introduction, this question did not require respondents to attribute economic change to NTAE production.

Subsamples of current and former producers of NTAEs were asked to evaluate change in their families' fortunes during the entire period they had produced the crops. The response of current NTAE producers was positive concerning perceived economic change for their families over the duration of time during which they had produced NTAEs (Table 6). As they looked back over their production histories, 57% of current NTAE producers felt that their families' economic situation had improved. Most of the remainder felt that there had been little change; this number may have been influenced by the relatively short time span of production for many families. Only 7 % felt their economic situation had worsened. Even among individuals who no longer produced NTAEs, the majority felt they were better off (35%) or the same (45%) as before they began to produce these crops (Table 7). (Most former producers abandoned production because they had largely retired from farming as their families matured and children began producing on their own or moved away).

Both current and former producers of NTAEs reported perceptions of whether producing each crop had been a good strategy for maintaining a family. Three-fourths of snow pea producers concluded that snow peas provided a reliable livelihood strategy, although 15%

stipulated good snow pea prices. A similar proportion of broccoli producers reported their crop provided a good livelihood strategy.

Perceptions of Capital Constraints and the Sustainability of Economic Growth through NTAE Production

Current and past producers were asked to name three things that would enable them to make more money from NTAE production. The survey instrument provided cues: "For example, do you need more land? Credit? Irrigation? Labor? Market access? Improved yields? Better product quality?" Most respondents stated that their most pressing need was credit or other sources of money to invest in production; more land was the second greatest need, followed by better access to markets. Even in a year of low prices, farmers emphasized factors of production and market access over better prices. Additionally, several farmers replied that lack of irrigation hampered production. Among former producers, over two-thirds planned to return to NTAE production. These individuals cited the same needs for improved economic returns as current producers, emphasizing production finance even more than current producers. (Of the five former producers who did not plan to return to NTAE production, two said the crops were not profitable and one cited heavy losses; the others no longer pursued NTAE production because of old age.)

Employment in NTAEs

Non-traditionals provided considerable employment in Xenimajuyú and Xeabaj. Among all members of the community, 69% said that at least one person in their families had worked in NTAE production (interpreted generally as household production) during the previous five years. On average, 3.5 three family members had worked in NTAE production in these families. Wage work in the NTAE fields had provided employment for 57% of families and a total of 252 individuals. In 2000-2001, local growers employed an average of 5 laborers for snow pea production. The largest-scale operation employed 40 laborers. Broccoli producers also employed an average of 5 laborers, with the largest employer paying 11 workers. Non-farm work related to NTAEs also provided employment for a few families. Nine percent of household heads had worked in packing plants or in the commercialization or transportation of NTAEs. Including all family members, 17 individuals had worked in packing plants; 15 commercialized crops; and 12 worked in transportation. While the proportion of

Differences Between NTAE Producers and Non-Producers on Global Perception of Economic Change

Several statistical tests were performed to determine whether there were statistically significant differences in the perceptions of family economic change trajectories among current producers, former producers, and people who had never produced NTAEs (Table 8). The independent variable in these tests was a three-point ordinal scale on which degree of NTAE involvement was ranked: 0 = never produced NTAEs; 1 = former producer; and 2 = current producer. The dependent variable for all tests was a five-point ordinal scale ranking the individual's perception of own family's current economic well-being compared with the time period before NTAE production was adopted in the community. The ranking on the perceived family economic trajectory scale was: 1 = much worse; 2 = worse; 3 = about the same; 4 = better; 5 = much better. None of the tests found a significant difference among groups.

One plausible interpretation for this finding is that, because households diversify income sources, family fortunes do not rise or fall according to the proceeds of NTAE production alone. Small-scale planters diversified their economic portfolios to reduce shocks from crop losses faced without crop insurance; price fluctuations; product rejection owing to sanitary and phytosanitary violations at port of entry; marketing bottlenecks; scarce and expensive credit received without any form of loan insurance; and rising costs for inputs.The fact that most NTAE producers planted relatively small amounts of NTAEs could also reduce disparities between producers and nonproducers. Also, NTAE production generated income for many nonproducers.

Positive Social Change

Respondents also provided information concerning perceived changes in quality of life, including education and nutrition. Changes were perceived as overwhelmingly positive. Ninety-four percent said that children stayed in school longer now than before NTAEs came to the community, and 68% of NTAE producers had used money from production to pay for their children's education. The same proportion had used NTAE funds for education of sons and daughters. There were no gender differences in the perceived level of regular school attendance for children in families that produced NTAES. Parents said that about one-third of their girls and boys attended school more regularly than before the family produced NTAEs, while only 4% said the children attended school less often. Since the fine work of Elizabeth Katz demonstrated that women's work in the NTAE fields often resulted in daughters doing housework, the issue of

girls' education in NTAE-producing families has been an important, though little investigated, issue.

Among women, positive changes in family nutrition and health care were reported. Nearly two-thirds of women reported improved diet for their families and 85% of NTAE-producing families said that money from NTAEs had helped them to improve family diet. In NTAE-producing households, three-fourths of women said that their families produced an equal or greater amount of maize per household requirement than before they began to produce for export. However, the minority who reported producing less maize also said they were unable to obtain the remainder of their household requirement. Over two-thirds of women in NTAE-producing households said they were able to provision their families with more meat than before they began export production, and 58% said they ate the same amount of meat. While these results are mixed, the direction of change is perceived to be positive or neutral for a majority of women on all measures, and NTAE proceeds do contribute to positive change.

When women were asked if they wanted their families to continue producing NTAEs, 95% said yes. When asked why, virtually all voiced some form of perception that NTAEs offered the most lucrative and/or most stable form of income generation available to them. (Of those who did not want their families to continue, lack of land, old age, and the high price of inputs were mentioned.) This finding speaks to the lack of alternative forms of income generation as well as to the relative status of NTAEs as a positively-perceived source of income. However, it also suggests that women do not consider that they and their children have been left out of the benefit stream. As demonstrated in Table 9, there are no differences in the perceptions of men and women concerning their families' economic trajectories across degrees of involvement in household NTAE production.

Summary

These results show that, in the communities as a whole, the period of NTAE production was generally associated with an improved or stable family economic situation and quality of life. NTAE production was generally perceived as a good way to make a living. Current producers considered themselves to be better off economically than before they began NTAE production. NTAE production provided considerable employment in the communities. Most producers indicated that, if they had greater liquidity and a larger land base, they could produce more than their current output. NTAE production appears to offer potential for sustainable

economic growth and improvements in social and economic well-being in the study communities.

Economic and Social Impacts: Gender[9]

The 1998 subsample used for analysis of women's control of land and other productive resources includes the 87 households in which an interviewee reported producing crops for domestic or export markets. Only interviewees in these households were asked to report resource-control decision patterns. In 17% of households, both male and female household heads were interviewed (some of these included widows and adult sons). In 4% of households, only a female head was interviewed. In the remainder, only the male household head was interviewed; 4% of these men did not have a spouse or partner. All interviewees responded to a single survey. If spouses supplied noncontradictory information, the common value was entered. In cases where values differed between spouses, the woman's response was entered. For the 2001 survey, both women and men were interviewed, separately, in virtually all households. Findings for the 2001 survey supported those of the 1998 survey, and will be noted where relevant.

In the study communities, only 22% of women have inherited or bought land individually—compared with 57% of men—while another 29% have bought land together with their husbands. Most women with independently-held land inherited from their parents or other relatives; the four widows have all inherited land.

Women were heavily involved in household production of NTAEs and other commercial crops. Among commercial producers, 94% of women worked in household production. Women were most likely to work in planting and harvesting both NTAEs and internally-marketed crops, with some one-fourth also involved in cultivation and one-tenth in land preparation. Women also marketed crops in many households. Women marketed strawberries in 69% of (26) producing households; 27% of (26) potato-producing households; and 17% of (58) snow pea-producing households. Women were considered the primary producers of income derived from nonbulk marketing of household crops (i.e., crops sold in regional markets rather than one-time sale to exporters and other bulk buyers) in 16% of all households. Women's primary control of nonbulk marketing provided income directly to women and yielded higher prices than bulk sales. Women also participated in decisions concerning selection of agrochemicals in nearly one-third of commercial agricultural households.

[9] Gender analysis has been published separately: Hamilton, Asturias, and Tevalán 2001a and 2001b.

Women did not appear to be marginalized from incomes derived from NTAE production. Although men dominated bulk marketing of snow peas and broccoli, women executed or shared primary control of incomes derived from sales in 69% of households with this form of income.[10] (In 2001, this pattern was confirmed when 67% of women in NTAE-producing households [N = 66] reported independent or joint control of NTAE earnings). Only 4% of women earned agricultural wages. Women's other sources of income included: managing small local stores and other petty commerce (25%); animal production (38%); selling agricultural produce in bulk (2%); agricultural market intermediary (2%); and property rental (3%). Women did not appear to forego independent income to work in household NTAE production. Women were more likely to have a farm-oriented independent productive base (primarily animal production) in households that relied more on NTAEs, rather than losing ground as household agriculture became more market oriented (Table 3).

Production of NTAEs also did not decrease women's control of land (Tables 3 and 4). Despite the domination of landholding and export marketing by men, three-fourths of commercial producers reported that land use decisions are made jointly between male and female household heads (Table 3). (In 2001, 77% of women in NTAE-producing households [N = 66] reported that they make land use decisions independently or jointly with male household heads.) The fact that so many women shared in or independently made land-use decisions—arguably the most important production decision a farming family makes—indicates that women have more of a voice in decisions concerning NTAE adoption and the extent to which a family will devote its resources to NTAE production than earlier studies suggested.

All women who owned land, and many others, made land use decisions. Multiple regression analysis (Table 4) was designed to explain women's control of land use by testing the independent effects of women's agricultural work, work as marketers of household production, independent ownership of land, joint ownership of land, status as single female household head,

[10] The survey did not quantify the proportion of this income directly controlled by women. The proportion of household income controlled by women was quantified in a 1994 study of a Kaqchikel community near Guatemala City, which showed that women in NTAE-producing households directly controlled 58% of all incomes; in households that derived all of their income from agriculture, women and men each controlled half of the income. It should be noted that, although many households were affiliated with a male-oriented production and marketing cooperative, women delivered snow peas to the co-op in 40% of producing households and marketed French beans in 60% of producing households, taking advantage of their proximity to urban markets (Asturias de Barrios and Tevalán 1996).

and amount of land planted to NTAEs. Women's work in these labor domains and chemical application for each production regime was coded to form a ten-point scale. Variation on this scale was entered into multiple regression analysis (below). Women's independent ownership of land and women's work in nonbulk marketing of agricultural products proved to be significant predictors of women's land use decision-making. Additional tests controlling for women's land ownership found that women who do not own land are more likely to make land use decisions if they market agricultural products (Gamma = 1; sig = .004). None of the other variables entered into the regression analysis was a significant predictor of land use decision-making for women without land.

The sample is relatively small for a multivariate analysis and the regression does not explain much of the variation in women's land use decision input. However, the regression does reflect observation that women make land use decisions on their own land whether or not they are single female household heads. The lack of association between joint ownership and women's input in land use decisions also corresponds to qualitative observation that joint ownership does not necessarily imply joint decision processes. The lack of association between a household's greater investment in NTAE production and women's participation in pest management decisions, land use decisions, and women's alternative income earning was also observed in bivariate tests (Table 3).

The results of the 2001 impact perception survey revealed similar patterns in intrahousehold decision-making. Impact perception survey results also found no differences between women and men concerning perceptions of household economic change following adoption of NTAEs, across levels of household involvement in NTAE production (Table 9). This finding is consistent with the decision measures reported above, which point to a less asymmetrical intrahousehold distribution of NTAE earnings than expected.

Environmental Impacts: Qualified Reduction in Agrochemical Use

Gains have been made in reducing reliance on pesticides, reducing reliance on the most toxic chemicals, and instituting nonchemical forms of pest management. Limited training in integrated pest management technologies has been offered by extensionists affiliated with the IPM CRSP, Altertec, and agroexporters. Most NTAE producers practice crop rotation, consult with technicians before fumigation concerning product choice and application procedures, change pesticides to avoid increasing pest tolerance, and consult concerning registration status of

pesticides to avoid the most harmful chemicals. Most also use the extremely effective "torito" (a mobile yellow sticky trap for snow pea leaf miner, *Liriomyza huidobrensis* (Blanchard) control) to decrease reliance on insecticides (Table 2). However, only about one-fourth scout pest populations before deciding to fumigate and even fewer use biological controls.

Most farmers in the region are following the insecticide application schedule established by San Juan Agro-Export (SJAE). Although SJAE recommended 20 insecticide applications during the 2000 growing cycle, a very high number, this represents a decrease from the 30 sprays recommended in 1990. About 70% of local NTAE producers follow the reduced-spray schedule. The remaining 30% continue to apply as many as 30 applications per growing season—the level established before widespread crop detentions resulted from pesticide residues in the mid-1990s. Although most applications are of insecticides, fungicides are routinely applied in the rainy season thus increasing the total number of "pesticides" applied (C. Richard Edwards, personal communication). Nonsustainable levels of fertilizer application apparently continue unabated. Most farmers have too little land to engage in the kinds of fallowing required to "rest" land that has been subjected to chemical overuse.

Local farmers indicated that virtually all producers who buy seed and fertilizer from the export company rigorously follow the company's production requirements. These farmers would be willing to adopt additional non-chemical integrated pest management technologies if the export companies included them in their production management protocols and requirements. Extensionists agreed with this assessment. Both farmers and extensionists believe that if a nationally-planned regional supply consolidation center becomes a reality, institutionalization of integrated pest management will be at a much higher level and pesticide use will be greatly reduced. This center, modeled on a pilot center established in the Western highlands, would have participation from local producer organizations, exporters, and food safety and environmental programs. Local producer organizations prefer to work directly with exporters, and such a center would offer expanded opportunities for such interaction and for adoption of more stringent pest control and pesticide residue standards.

Farmers' attitudes toward the use of pesticides are slowly changing as the minority who are self-organized to work with private extensionists experiment with non-chemical technologies and their knowledge slowly becomes diffused. In areas where farmers have access to larger

cooperative organizations, such as Quatro Pinos, dissemination of reduced-pesticide production management is disseminated more quickly and reinforced more regularly.

CONCLUSION

Small-scale producers continue to control the means of production for export agriculture in the Central Guatemalan highlands. Comparison of these case study results with earlier studies in the region indicates that the distribution of landholdings has changed little in the past ten years and that the proportion of the population engaged in NTAE production has remained stable and relatively high (see referenced studies by Barham, Carter, Katz, and colleagues). In contrast with other export production regimes in Central America, larger operations have not forced small-scale producers out of the market or off their small farms. Despite a formidable array of production and marketing constraints, small-scale growers and others in their communities believe that NTAE production is a viable means of achieving maximum value per land area and that NTAE production has the potential to provide sustainable income growth for their families. Because of these constraints, however, most producers plant only small proportions of their land to NTAEs. The most critical among these constraints are lack of production credit and insurance; soil degradation, crop loss, and product rejection due to nonsustainable overuse of agrochemicals; and individual marketing through unregulated regional market intermediaries for those producers not affiliated with an agroexporter or a cooperative.

One of the results of these constraints is that NTAE growers also produce other crops for internal and Central American markets, where food safety is relatively unregulated and even contaminated products can be sold. Prices are lower, but products do find a market outlet. A more positive observation is that most NTAE producers continue to produce traditional milpa (maize and beans) crops for household consumption.[11] Fears that NTAE production on small holdings would crowd out traditional production—which holds cultural as well as nutritional value—have not proved to be well grounded. Both because they prefer to secure basic grains provisioning from own production, and because they are unable to insure against the risks of NTAE production, most smallholders continue to produce traditional subsistence crops.

[11] The argument that farmers can improve family nutrition best by planting more NTAEs and using the higher earnings to buy these and a wider variety of foods is a reasonable one. The opposite argument—that food expenditures may not be a high priority for the males who directly collect most of their households' export earnings and that family nutrition can suffer in NTAE families—is also salient.

Both interhousehold and intrahousehold distributions of NTAE benefits proved more egalitarian than some of the earlier studies anticipated. Both household production returns and NTAE-related wage returns were widely distributed. NTAE production contributed to a modest decrease in land concentration. Women were found to control land and other economic resources to a surprising degree in NTAE-producing households, despite the perceived traditional division of labor in which men are primarily responsible for agricultural production. The social impacts of NTAE production in the case study communities were largely perceived as positive.

A partial explanation for these findings lies in the application of social and cultural capital to new market opportunities—a meeting of tradition and nontradition. Those producers who self-organized to work with exporters and those who applied traditional marketing skills to independent marketing endeavors did better than other producers and other members of producer families. In a parallel study of a community in a neighboring department, where producers had access to a production /credit/marketing cooperative, co-op members also received better prices than those who sold through intermediaries.[12] These individuals were at the same time economic innovators and conservators of socio-cultural traditions that encompass concepts of collective welfare, social organizational principles, and reaching for new markets. Women's traditional freedom to market independently and relevant marketing skills proved important in securing voice in NTAE-related intrahousehold economic decision processes.

Production and marketing constraints were alleviated somewhat by these socio-cultural assets. Given positive results achieved by traditional indigenous organizations in nontraditional markets elsewhere in Latin America (see note 2), these assets offer tremendous potential in terms of organizing to achieve better crop management, market opportunities, and environmental sustainability. However, sustainability in NTAE incomes and in the use of natural resources currently threatened by agrochemical use cannot be expected without well-targeted national and international investment and some market restructuring in the small-scale sector.

Given both the social and economic asset bases of small-scale indigenous Guatemalan producers and the structural constraints to individual accumulation, investment should be targeted to creation and support of organizational structures that allow small-scale producers to increase production through both ex ante and ex post access to capital and to capitalize on

[12] Price differentials were highest for snow peas; producers whose local organization sold through exporters made one-third more than those who sold to intermediaries; those who sold through the co-op made nearly as much as direct-to-exporter sellers.

traditional forms of social and economic collaboration. Recommendations for organizational structures that allow vertical integration of production, processing, and marketing in the Guatemalan highlands are particularly well targeted to the Central highlands (Immink and Alarcon 1993). Those organizations that incorporate training and technical assistance in integrated pest management technologies and the sanitary and phytosanitary requirements of export markets can make the largest positive impact in terms of both economic and environmental goods. Structures that enable larger numbers of small-scale producers to work directly with agroexporters could achieve more sustainable results for both exporters and producers (Julian, Sullivan, and Sánchez 2000) and offer the potential for private industry investment.

Constraints to local production expansion and environmental problems can be alleviated through these forms of investment in the small-scale NTAE sector. However, the most sustainable restructuring would require significant land redistribution. Public market-based approaches have yet to achieve this end and the political will does not appear to be present for other approaches. Current efforts by international donors and others to find creative forms of market-based redistribution that take into account the realities of both macro and micro political economies offer some hope and should be expanded. Nonagricultural development processes could also relieve distributional constraints. A more desirable rural development scenario would include both land redistribution and nonfarm employment options that currently are not available to the case study communities—those deriving from decentralized nonagricultural production, the infrastructure that would make this possible, and improved rural education systems.

The research results reported here demonstrate that NTAE production can contribute to genuine rural development and poverty alleviation. In highland Guatemala, NTAE production has offered viable opportunities for local producers to control their own means of production and has provided employment for farm families and other community members. Within the political economic context of highland Guatemala in the late twentieth and early twenty-first centuries, nontraditional export production has helped rural people achieve remarkable, if incremental, social mobility. These findings[13] suggest that donors' and producers' investments in improving the sustainability of small-scale agricultural export production can yield increasingly positive long-term social and economic results.

[13] See comparable studies from elsewhere in Latin America by Bebbington (1996) and González (1998).

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TABLES

Table 1 . Nontraditional Agricultural Export Production as a Function of the Amount of Land Controlled by Households (land owned plus land rented in, minus land rented out)
Xenimajuyú and Xeabaj, Chimaltenango 1998

	Hectares Controlled by Households, in quartiles				*Sample*
	.03 - .49 (N = 50)	.5 - .99 (N = 43)	1 - 2.49 (N = 29)	2.5 - 32.6 (N = 12)	*(N = 134)*
Percentage planting NTAXs	30%	61%	55%	75%	*49%*
Gamma = .416; p = .001					
ANALYSIS OF VARIANCE for subsample planting NTAXs					
Households planting NTAXs	Subsample N = 15	Subsample N = 26	Subsample N = 16	Subsample N = 9	Subsample N = 66
Mean no. of hectares in NTAXs	.14	.14	.29	1.0	.29
Standard Deviation	.07	.05	.20	1.4	.59
Minimum	.06	.06	.08	.23	.06
Maximum	.39	.23	.68	4.74	4.74
F = 7.005; p = .007					
[1] mean differences among groups are significant at <.01	* Group 4	* Group 4	*Group 4	* Groups 1, 2, 3	
Homogeneous subsets using harmonic mean group size of 14.35	Subset 1	Subset 1	Subset 1	Subset 2	

[1]Caution should be used in interpreting significance levels for groups of these sizes. For procedure using harmonic means, type 1 error levels are not guaranteed.

Data Source: IPM CRSP-Estudio 1360 household surveys, Chimaltenango, 1998

Table 2. Perception of Family Economic Trajectory Following the Introduction of Nontraditional Export Crops into Community (1985-2001), Xenimajuyú and Xeabaj (Chimaltenango), N = 211

Economic situation is:		
Much better	14	6.6%
Better	107	50.7%
The same	77	36.5%
Worse	9	4.3%
Much worse *Than before NTAEs*	4	1.9%
Sum	*211*	*100%*

Data source: IPM CRSP/Estudio 1360/University of Denver Impact Perception Survey, 2001

Table 3. Current NTAE Producers' Perception of Total Family Economic Trajectory During NTAE Production, Xenimajuyú and Xeabaj (Chimaltenango), N = 134 Current Growers

Much better	7	5.2%
Better	68	50.7%
The same	50	37.3%
Worse	7	5.2%
Much worse	2	1.5%
Sum	*134*	*100%*

Data source: IPM CRSP/Estudio 1360/University of Denver Impact Perception Survey, 2001

Table 4. Former NTAE Producers' Perception of Total Family Economic Trajectory During NTAE Production, Xenimajuyú and Xeabaj (Chimaltenango) , N = 20 Former Producers

Much better	1	5%
Better	6	30%
The same	9	45%
Worse	3	15%
Much worse	1	5%
Sum	*22*	*100%*

Data source: IPM CRSP/Estudio 1360/University of Denver Impact Perception Survey, 2001

TABLE 5. Women's Marketing and Participation in Household Production Decisions by Level of Household NTAX[a] Production

N = 87 Commercial Agricultural Producing Households
Chimaltenango 1998

Hectares planted to NTAXs by household		Markets Berries	Markets Potato	Markets Snow Peas[c]	Controls NTAX Income[d]	Produces Animals[d] *	Controls Land Use[d]	Controls Inputs[d]
		%	%	%	%	%	%	%
0 [b]	N 21	73 (N=15)	50 (N=4)	0	71	24	91	48
.06-. 11	N 37	63 (N=8)	38 (N=8)	15 (N=34)	68	32	68	27
.23-4.74	N 29	67 (N=3)	15 (N=14)	21 (N=24)	69	55	76	24
TOTAL	N 87	69 in (N=26)	27 in (N=26)	17% in (N=58)	69 (N=87)	38 (N=87)	76 (N=87)	31 (N=87)

[a] Nontraditional agricultural exports (snow peas and broccoli)
[b] Produce variety of commercial crops, for domestic market only
[c] Women did not sell broccoli in the 15 households that produced the crop.
[d] Statistical tests of correlations between level of NTAX production and intrahousehold socioeconomic indicators were computed for households that produce commercial crops (N = 87). * Gamma is significant at p = <.05.

Data Source: IPM CRSP-Estudio 1360 household surveys, Chimaltenango, 1998

TABLE 6. Predicting Women's Participation in Land Use Decisions

Xenimajuyú and Xeabaj, Chimaltenango 1998
Logistic Regression Model
Forward Stepwise Entry [c]
Model X^2 = 13.403
Significance of X^2 = .001
R^2 = .225
N = 84
Dependent Variable: Women's Participation in Land Use Decisions [a]

Independent Variables

Variables in the Equation	**Change in –2 Log Likelihood**	*Sign Change*
Woman inherited land	5.442	.020
Woman sells ag. products	5.442	.005
Variables not in the Equation	**Score**	*Sign. Score*
Has. Planted to NTAXs	2.416	.120
Women's work in commercial agriculture [b]	.068	.795
Single female household head	2.300	.129
Woman owns land jointly with husband	.023	.897

[a] Reported by male and female householders, one response per household; when reports differed, woman's response was entered. Woman as primary decision maker or partner in joint decisions coded as 1; decision primarily by man coded as 0.
[b] The extensiveness of women's involvement in household agricultural labor is scaled with participation in each of the following labor domains coded as 1, for each production regime (domestic market, NTAXs): planting, cultivation, harvesting, and application of chemicals. Scale varies from 0 to 10.
[c] Likelihood-ratio test for removal of variables.

Data Source: IPM CRSP-Estudio 1360 household surveys, Chimaltenango, 1998

Table 7. Integrated Pest Management Use in NTAXs, by Community (Percentages) Chimaltenango, Guatemala 1998

	Xenimajuyu (n=30)	Xeabaj (n=36)
Uses rotation	93.3	88.9
Uses natural controls	23.3	16.7
Counts pests before fumigation	26.7	22.2
Consults technician before fumigation	66.7	58.3
Changes pesticide to prevent tolerance	90.0	88.9
Uses sticky or color traps	66.7	47.2
Uses protective equipment	70.0	97.2
Consults whether pesticides are registered	83.3	94.4
Keeps registry of pesticide application	40.0	55.6
Has received capacitation in IPM	56.7	61.1

Data Source: IPM CRSP-Estudio 1360 household surveys, Chimaltenango, 1998

Table 8: Perceived Family Economic Trajectory on Global Measure by Degree of Involvement in NTAE Production, Xenimajuyú and Xeabaj (Chimaltenango) N = 211

		Never Produced NTAEs		Former Producer		Current Producer		*Total*	
Perceived Family Economic Trajectory		N	%	N	%	N	%	*N*	*%*
Much worse (value = 1)		2	3.5	0	0	2	1.5	*4*	*1.9*
Worse (value = 2)		3	5.3	1	5.0	5	3.7	*9*	*4.3*
About the same (value = 3)		21	36.8	6	30.0	50	37.3	*77*	*36.5*
Better (value = 4)		28	49.1	11	55.0	68	50.7	*107*	*50.7*
Much better (value = 5)		3	5.3	2	10.0	9	6.7	*14*	*6.6*
Totals		*57*	*100*	*20*	*100*	*134*		*211*	*100*
Statistics	Gamma = .045; p = .694 Spearman Corr. = .027; p = .692 *Note: Analysis of Variance tests also found no significant differences among groups:* *F = .725; p = .485*								

Data source: IPM CRSP/Estudio 1360/University of Denver Impact Perception Survey, 2001

Table 9: Perceived Family Economic Trajectory on Global Measure by Degree of Involvement in NTAE Production, by Gender, Xenimajuyú and Xeabaj (Chimaltenango) N = 211 (103 men; 108 women)									
		Never Produced NTAEs		Former Producer		Current Producer		*Total*	
	Perceived Family Economic Trajectory	N	%	N	%	N	%	*N*	*%*
Men	Much worse (value = 1)	1	4.2	0	0	2	2.9	*3*	*2.9*
	Worse (value = 2)			1	9.1	4	5.9	*5*	*4.9*
	About the same (value = 3)	11	45.8	2	5.7	22	32.4	*35*	*34*
	Better (value = 4)	11	45.8	8	72.7	35	51.5	*54*	*52.4*
	Much better (value = 5)	1	4.2	0	0	5	7.4	*6*	*5.8*
	Totals	*24*	*100*	*11*	*100*	*68*	*100*	*103*	*100*
Statistics	Gamma = .071; p = .664 Spearman Corr. = .041; p = .682								
Women	Much worse (value = 1)	1	3.0	0	0	0	0	*1*	*.9*
	Worse (value = 2)	3	9.1	0	0	1	1.5	*4*	*3.7*
	About the same (value = 3)	10	30.3	4	44.4	28	42.4	*42*	*38.9*
	Better (value = 4)	17	51.5	3	33.3	33	50.0	*53*	*49.1*
	Much better (value = 5)	2	6.1	2	22.2	4	6.1	*8*	*7.4*
	Totals	*33*	*100*	*9*	*100*	*66*	*100*	*108*	*100*
Statistics	Gamma = .029; p = .854								
	Spearman Corr. = .018; p = .854								

Data source: IPM CRSP/Estudio 1360/University of Denver Impact Perception Survey, 2001